NOTES ON THE BEHAVIOUR AND NESTS OF AN AUSTRALIAN MASARID WASP *PARAGIA (PARAGIA) DECIPIENS DECIPIENS* SHUCKARD (HYMENOPTERA: VESPOIDEA: MASARIDAE)

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Abstract

Females of *P. decipiens* excavated turretless nests in hard clay at Fowlers Gap in arid, western New South Wales. Females alighted on water surfaces and imbibed water for use in softening the nest substrate. Nests were provisioned with pollen of *Eucalyptus camaldulensis*. Males were attracted to nest entrances, water and honeydew.

Introduction

As far as is known, most non-Australian species of masarid wasps are like solitary bees in that they provision their nests with pollen and nectar (Richards, 1962; Gess and Gess, 1980). Species of only one of the masarid subfamilies, the Nearctic Euparagiinae, are predatory (Clement and Grissell, 1968) as are all other Vespoidea. Carpenter (1982) has argued that the Masaridae *sensu* Richards (1962) is a paraphyletic group, and that the Euparagiinae is the sister-group to all other vespoids.

All Australian species of Masaridae belong in the subfamily Masarinae (*sensu* Richards, 1962) and most are poorly known biologically. Wilson (1869) observed females of *Paragia (Paragia) smithii* Saussure entering turreted burrows in the ground, and Richards (1968) noted flower-visiting by two species of *Riekia* Richards, but the only detailed descriptions of nesting sites and nest structures are those of Houston (1984), for *Paragia (Paragia) tricolor* Smith.

Although rarely collected, masarids can be locally abundant, particularly around pools of water in otherwise arid regions. Such a congregation of masarids was drawn to our attention in 1981 by Dr J. M. E. Anderson, of the University of New South Wales, who had collected large numbers of four species of *Paragia* [*P. (Paragia) decipiens decipiens* Shuckard, *P. smithii, P. (Paragiella) odyneroides* Smith, and an undescribed species] at Fowlers Gap Arid Zone Research Station in western New South Wales. Our observations on the first of these species (referred to below as *P. decipiens*) were made at Fowlers Gap during 1981 and 1982, and complement Houston's (1984) account of *P. (P.) tricolor*. *P. decipiens* is a medium sized masarid (body length 12-17 mm), with known distribution as shown in Fig. 4.

Study site

Observations were made at the headquarters of the Fowlers Gap Arid Zone Research Station (31°05′S, 141°42′E), approximately 100 km NNE of Broken Hill. The Station has an average annual rainfall of 240 mm, which is evenly distributed throughout the year. Rainfall is unreliable and often occurs as brief showers which do not moisten the soil to depths below 6 mm (see Specht, 1972). November-March temperatures generally fluctuate between 12-22° (daily minimum) and 30-40°C (daily maximum); whereas May-September temperatures lie between 2-9°C and 17-28°C.

Fig. 1. Nesting areas (arrowed) of *P. decipiens decipiens* at Fowlers Gap, New South Wales.

Nests of *P. decipiens* were located in disturbed areas adjacent to buildings, in areas of low grass and herbs where a few species of eucalypts had been planted, and in an earth road adjacent to a creek (Fig. 1; creek flanked by a woodland formation dominated by *Eucalyptus camaldulensis* Dehnh). The study area was surrounded by treeless shrubland in which no masarid nests were discovered.

Adult wasps were observed in the above areas and around pools of the creek, a man-made earth dam, and a tiled swimming pool in the grounds of the Research Station. Observations were made during the periods 29 November-2 December, 1981, and 8-10 December 1982.

Female behaviour

Water visiting

Adult females of *P. decipiens* alighted on the surface of water in natural pools in the creek bed, in the earth dam and in the swimming pool. The relatively muddy waters of the creek bed and dam, and the clear, chlorinated water of the swimming pool appeared to be equally attractive to wasps. A few

dead wasps floated on the surface of the swimming pool but not on the surface of water in the creek bed or in the dam. Possibly these wasps were killed by the chlorinated water. On the other hand, we observed that occasionally the wings of wasps accidentally came in contact with the surface of the water and were held there. Wasps trapped in this way could neither fly nor scale the vertical, smooth, tiled walls of the pool. The banks of the creek-bed pools and dam sloped gradually and we observed that wasps which were trapped temporarily by surface tension would eventually drift to these banks, gain a footing and escape.

Water surfaces were frequented by four species of Masaridae (see list above) and several species of Eumenidae and Sphecidae. All masarids and eumenids drank with the body horizontal, with their tarsi and at least part of the metasoma in contact with the water. Sphecids drank with the long body axis at least 30° above the horizontal.

On taking off after drinking, adults of *P. decipiens* sometimes dragged the apex of the metasoma in the water for a horizontal distance of 10-20 cm. Presumably, *P. decipiens* carries water in the crop, as do other vespoid wasps. Adults of *P. decipiens* frequented water from about 10 am to about 3 pm.

Nest excavation

The following notes are based on interrupted observations of one female in 1981. An excavation cycle consisted of:–

(i) An absence from the nest of 55-120 seconds (average 89 seconds, n = 9). The female left the nest and flew towards the earth dam and presumably imbibed water there. Several brief absences (up to 20 seconds) were also observed. These might have been short orientation flights in the immediate vicinity of the nest. Several longer absences (more than 13 minutes) were not explained.

(ii) 2-5 intervals, each of 15-62 seconds (average 34 seconds, n = 48) spent underground. A mud pellet was discarded from the nest at the end of each of these intervals. Presumably the female regurgitated water from the crop to soften the hard clay. Mud pellets were discarded in two different ways:–

  (a) the female emerged from the nest, flew 15-30 cm from its entrance, dropped the pellet, and returned to the nest (total duration: 1-2 seconds);

  (b) the female dropped the pellet 1.0-1.5 m from the nest entrance as it flew off towards the dam, thus completing an excavation cycle.

Pollen collection

Adult females were collected at flowers of *E. camaldulensis* but not at flowers of another unidentified species of *Eucalyptus* or those of small shrubs in the vicinity. Pollen in the only larval food mass removed from a nest was of the one type and microscopically matched pollen sampled from *E. camaldulensis*. Pollen was carried in the crop of the female and, judging from

the size of the crop and the size of the larval food mass, several provisioning journeys would have been necessary to build up the pollen mass.

Male behaviour

Males of *P. decipiens* alight on water surfaces and drink in company with females. On one occasion a male attempted to mate with a female on the ground near the swimming pool. Several males spent long periods (up to 20 minutes) on the ground watching open nest entrances.

Large numbers of males of *P. decipiens* (as well as both sexes of many other Hymenoptera) were attracted to new growth on one unidentified eucalyptus tree growing near the swimming pool. Apparently the wasps were seeking honeydew produced by cicadellid nymphs. Female masarids were not attracted in the same way.

Nests

Several short, vertical burrows (depth 4-5 cm) were located within 5 m of the swimming pool. One of these contained a dead female of *P. decipiens.*

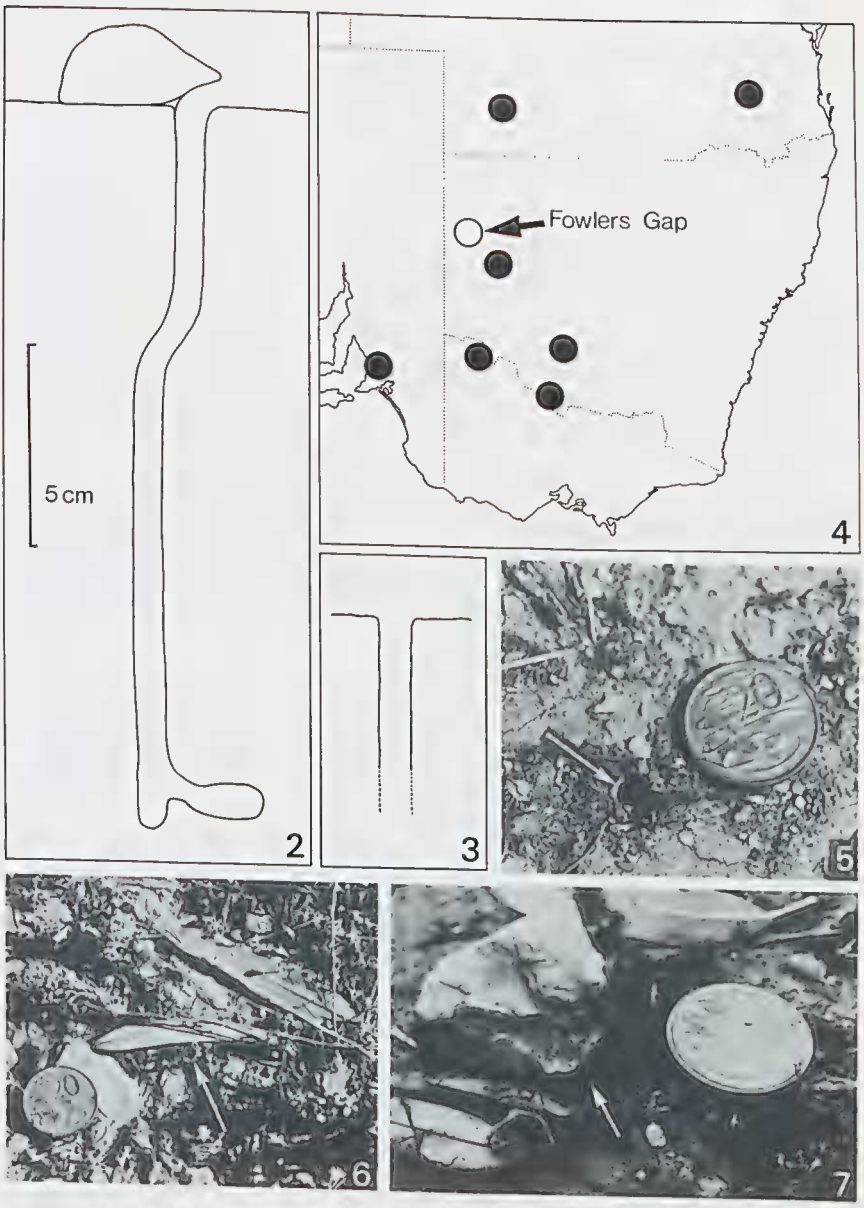
Sites of active nests were 50-300 m from water and flowering *E. camaldulensis*, in hard, compacted clay.

Five active nests were excavated. One contained a single larval cell but four had no cells. Each nest consisted of a vertical shaft, which was circular in cross-section and narrowed quickly to a diameter of 5-7 mm (Fig. 2). Four of the five shafts had a slight bend 5-10 cm below the surface. The inner surfaces of the shaft were smooth. The horizontal larval cell was connected to the vertical shaft by a very short, open access shaft. The cell (including the access shaft) was approximately 23 mm long and attained a maximum diameter of 9 mm near the rounded blind end. The walls of the cell were 1-2 mm thick, apparently of compacted clay, and large fragments could be removed from the surrounding, softer matrix. The inner surfaces of the walls were smooth and unlined. The entrances to the nests were approximately 10 mm in diameter and were either exposed (Fig. 5) or (more commonly) concealed by a leaf or rock (Figs 6, 7). Entrances were not surmounted by turrets (Fig. 3). However, where entrances were concealed beneath leaves or rocks, the shaft was extended above ground level as an incomplete, thin-walled tube (Fig. 2).

The larval food mass was a soft, yellow, moist, irregularly-shaped loaf on which the larva fed externally. The only larva collected has been preserved in the Australian National Insect Collection, CSIRO, Canberra.

Natural enemies

A species of *Anthrax* Scopoli (Diptera: Bombyliidae) and one of *Hyptiogaster* Kieffer (Hymenoptera: Gasteruptiidae) entered nests of *P. decipiens* (several observations of each) but neither was confirmed to be a parasite of *P. decipiens.* Twenty-five per cent (n = 24) of adult females and 13% (n = 54) of adult males were stylopised. Stylopised specimens have been preserved in the Australian National Insect Collection.



Figs 2-7. *P. decipiens decipiens*: (2) nest with concealed entrance and larval cell, vertical section; (3) exposed nest entrance, vertical section; (4) distribution map; (5, 6, 7) nest entrances (arrowed).

Abundance

P. decipiens was abundant at Fowlers Gap during December, 1979. Up to 150 adults were present simultaneously around the swimming pool (Anderson, pers. comm.; unpub. photographs). During our 1981 visit, 30 adults at most were present at the pool at any one time. In 1982 there were five at most.

Discussion

In alighting on the water surface to drink, *P. decipiens* behaves similarly to *P. smithii* and *P. odyneroides* (Naumann, pers. obs.) and several South African masarid species [*Ceramius capicola* Brauns, *Ceramius linearis* Klug and *Ceramius lichtensteineii* (Klug)] reported on by Gess and Gess (1980). *Jugurtia confusa* Richards, another South African masarid, stands on mud at the edge of water to drink (Gess and Gess, 1980). *C. capicola, C. lichtensteineii, J. confusa* and *P. decipiens* all have water collection intervals of about the same duration. *P. decipiens* excavates and discards each mud pellet from the nest 2-4 times more quickly than *Ceramius* spp. (Gess and Gess, 1980). *P. decipiens* disposes of pellets over a wide area, always more than 15 cm from the nest entrance, as do *C. lichtensteineii* and *J. confusa.* Presumably widely dispersed pellets do not draw the attention of parasites to nest entrances. In contrast, *C. capicola* deposits pellets in a discrete area much closer to the nest entrance. Houston (1984) did not describe water collection or pellet disposal by *P. tricolor* females.

The general structure of the nest of *P. decipiens* is similar to that of *P. tricolor* (Houston, 1984) and those of most of the investigated non-Australian, ground-nesting masarids (Gess and Gess, 1980). However, in *P. tricolor* the entrance is extended above ground level by a mud turret. Nests of two other Australian masarids, *Rolandia maculata* (Meade-Waldo) and an undescribed species of *Riekia*, also appear to be turretless (Houston, 1984), as are most nests of *J. confusa* (Gess and Gess, 1980).

Compacted, clay turrets or funnels at the entrances of wasp nests exclude at least some parasites (Smith, 1978) and, in the case of ground nests, may also exclude wind-blown surface particles. Because of their fragile construction, it is unlikely that they prevent flooding during rainstorms, which seems to be the function of turrets surmounting gryllacridid burrows in arid Australia (Morton and Rentz, 1983). The entrances to *P. decipiens* nests are usually concealed. Perhaps, concealment confers the same protection against parasites as does the turret in other species..

Nests of *P. tricolor* and non-Australian masarids are multi-celled. At Fowlers Gap, the only nest of *P. decipiens* containing a larval cell was still active, and it is possible that older nests of *P. decipiens* are multi-celled. Only one female *P. decipiens* is associated with each nest. It is not known whether nests are re-used by successive generations of wasps.

As far as is known, *P. decipiens* collects only *E. camaldulensis* pollen. *P. tricolor* only collects pollen of either *Eucalyptus calophylla* R. Br. or *Eucalyptus cylindriflora* Maiden and Blakely, and Houston (1984) correlates

seasonality in *P. tricolor* activity with flowering periods of these two trees. The larval food mass of *P. decipiens* is more soft and moist than that of *P. tricolor* and lacks regular folds and annulations.

The apparent decline in the population of *P. decipiens* from 1979 to 1982 may be correlated with very low rainfall and increasing "drought" conditions in the area. For successful nesting, *P. decipiens* requires nesting sites, water and pollen. In 1981 and 1982 at Fowlers Gap, none of these requirements appeared to be a limiting factor, the swimming pool being filled with bore water, and at least some *E. camaldulensis* being in flower. We speculate that a minimum fall and soil penetration of rain is necessary to stimulate or enable emergence of *P. decipiens* from the subterranean cells in which they have completed their larval and pupal development, and that this minimum requirement was not generally met in the months prior to our 1981 and 1982 visits.

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